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ABSTRACT

In April 1989, the National Council of Teachers of Mathematics issued a major report which presented 13 standards for elementary school mathematics. Among the most important and wide reaching of the Standards are those stating that the study of mathematics should emphasize problem solving, mathematical reasoning, and number sense. The project described in this report used Eisenhower funds to provide inservice training for 131 elementary school teachers and 19 principals and focused on the latter two goals of the Standards: promoting mathematical reasoning and developing number sense. Included in this document are a description of the workshop series and evaluation data which indicates why the program was effective. Appended are an evaluation report, copies of the evaluation instruments, and a recruiting brochure. (Author/CW)

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IMPLEMENTING THE NCTM STANDARDS FOR SCHOOL MATHEMATICS FOR THE 21ST CENTURY

Final Report to the Indiana Commission for Higher Education

October 1, 1990

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The Mathematics Education Development Center

Indiana University, Bloomington

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Abstract

In April, 1989, the National Council of Teachers of Mathematics issued a major report entitled *Curriculum and Evaluation Standards for School Mathematics*. This document presented thirteen standards for elementary school mathematics, among the most important and wide-reaching of which are standards stating that the study of mathematics should emphasize *problem solving*, *mathematical reasoning*, and *number sense*. The project described in this report was a continuation and extension of another inservice project which focused on helping teachers to understand how elementary school mathematics could be taught through a *problem-solving* approach (See *Mathematics for the 21st Century: Preparing Elementary Teachers*, ERIC Document ED 312 415). The current project utilized Eisenhower funds to provide inservice training for 131 elementary school teachers and 19 principals and focused on two other goals of the *Standards*: promoting *mathematical reasoning* and developing *number sense*.

The major component of the project described here was six keynote workshops by nationally known experts in elementary mathematics education. Follow-up was provided only for those participants involved in a concurrent inservice project. A surprising finding of this project was that even without follow-up, most participants felt the workshops were influential in getting them to improve their teaching. While reasons for this are not completely clear, three factors appear to be keys. First, those who changed most were all open to change before the workshops began. Second, the workshop speakers were dynamic, motivating individuals who were able to get teachers excited about change. Third, those who changed had peer and administrative support for improved teaching.

In this document, information which describes the workshop series will be found along with evaluation data which indicate why the series was effective. The document was written to fulfill the requirement for a final report on the project. The format of the document follows guidelines from the funding agency (the Indiana Commission for Higher Education). However, **this document is also intended as a "how to" guide for school corporation personnel interested in carrying out a similar inservice workshop series** and thus provides tips and information beyond the minimum required for a final project report.

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INDIANA COMMISSION FOR HIGHER EDUCATION
TITLE II/EISENHOWER PROJECTS

Final Project Report
Year Four (1988) Funding

1. *Project Number:* **88-COM-14**

2. *Sponsoring Institution:* **Indiana University, Bloomington**

3. *Project Title:* **Implementing the NCTM Standards for School Mathematics for the 21st Century**

4. *Project Director:* **Diana L. Kroll, Ph.D.**
   Co-Directors: **Carol J. Fry, Ph.D.**
   Jacqueline Gorman, M.S.
   Peter Kloosterman, Ph.D.
   John F. LeBlanc, Ph.D.
   Frank K. Lester, Jr., Ph.D.
   Project Evaluator: **Sarah Cassell, M.S.**

5. *Names, Addresses of Cooperating Institutions, Agencies, Foundations, etc., apart from Schools:* **None**

6. *Names, Addresses of Cooperating Schools:*

   Although planning was done exclusively by project staff with advice from teachers and administrators in the Monroe County School Community School System, the following school corporations were represented at the workshop series. A complete list of schools and of individuals served can be found in Appendix E.

   Bartholomew Community
   Brown County
   Center Grove Community
   Clay Community
   Nineva-Hensley-Jackson United
   North Lawrence Community
   Monroe County Community
   Perry Central Community
   Richland-Bean Blossom
   Washington Community

7. *Type of Project:* **Individual**

8. *Grade Level Served:* **Elementary**

9. *Subject Area:* **Mathematics**

10. *Project Format:* **Workshops** (several meetings, each lasting several hours)
    17 teachers from Dyer Elementary School also received individual assistance

11. *Major Activities:* **Instruction of teachers outside of class** (all participants)
Classroom observation, assistance (Dyer teachers only)

12. *College Credit for Participants:* **None**
Note: Teachers from the Monroe County Community School Corporation were eligible for inservice "PIVOT" credits required by the corporation. These credits are valid only within this school corporation.

13. *Number of public school corporations served:* **10**
Number of public schools served: **31**

14. *Number of private schools served:* **4**

15. *Number of teachers participating:* **131** (119 public + 12 private)

16. *Average number of contact hours per participating teacher:* **5.7**

calculation of average number of contact hours:

No. of teachers attending 5 workshops	30
No. of teachers attending 4 workshops	19
No. of teachers attending 3 workshops	22
No. of teachers attending 2 workshops	22
No. of teachers attending 1 workshop	38

(5 x 30) + (4 x 19) + (3 x 22) + (2 x 22) + (1 x 38) = 374 "workshop attendances"

374 workshops + 131 teachers = 2.85 workshops/teacher

2.85 workshops/teacher x 2 hours/workshop = **5.7 hours/teacher**

Note 1: This calculation is for workshop attendance only. Teachers from Dyer elementary school also received one-on-one assistance in their classrooms. This assistance was primarily funded by the National Science Foundation through the *Preparing Elementary Teachers to Teach Mathematics* project at Indiana University. While there was substantial variation in the amount each teacher utilized this support, it averaged about 1 hour of individual assistance per teacher per week for the school year. Thus **each of the 17 Dyer teachers received an average of 36 additional contact hours**. If this assistance is included in the "grand total" of average number of contact hours per participating teacher, it becomes **10.4 hours/teacher**.

Note 2: 19 principals also attended a single two-hour session. This participation was not included in any of the above totals.

17. *Number of students participating:* **none**

18. *Number of students indirectly affected (explain basis for estimate):* **3,275**
(131 teachers x 25 students/teacher = 3,275 students)

Note 1: This calculation assumes little impact on students of teachers who did not attend the workshops yet evaluation data reported in Appendix A indicate that, on the average, teachers shared ideas and handouts with at least two other teachers who did not attend. Based on this "sharing," the case could easily be made that about three times as many students

(approximately 10,000) were indirectly affected.

19. *Number of non-teacher, non-student participants (Describe):* **27**

elementary school principals	19
Indiana Univ. graduate students	6
other school administrators	2
total	27

20. *Characteristics of participants: Ethnicity*

We did not collect specific ethnic data from the participants. **Four black teachers** attended one or more of the workshops. To the best of our knowledge, **all other participants (154) were white.**

Gender

Based on first names in cases where we did not have specific gender information, **28 participants were male and 126 were female.** Note that 12 of the 28 males were principals who only attended the workshop for principals.

Current teaching responsibilities

All 131 teachers who participated were teaching mathematics. We assume most of them were also teaching science although, because the focus of the workshops was strictly mathematics, we did not collect data on the number who were teaching science. Three of the Indiana University graduate students were teaching IU mathematics courses. Although a number of the administrators claimed to be working with their teachers on mathematics, we know of no cases where any other non-teacher participants were assigned to teach mathematics or science.

21. *Project staff/instructors:*

Project staff:
4 Faculty from School of Education (Fry, Kloosterman, LeBlanc, Lester)
3 School of Education Professional Staff (Cassell, Gorman, Kroll)

Workshop speakers:
4 Non-local Faculty (Irons, Leutzinger, Ockenga, Trafton)
1 School District Curriculum Superviser (Peterson)
1 Private Consultant (Cook)

Teacher Advisory Team:
6 School Teachers (Dyer teachers Bays, Burnett, Calkins, Lemon, Merrifield, Miller)

22. *Sources of funding:*

Federal (Title II/Eisenhower)	**$ 29,999.**
Federal (Other)	**none**
Non-Federal (Describe)	
Matching Share	
Indiana University ($10,185)	
Cooperating Schools ($1,000)	**$ 11,185**

23a. Project Cost:

Note: The following are budgeted totals. Exact expenditure totals will be sent by the Indiana University Grants and Contracts Office when all bills have been finalized. This should occur about December 15, 1990.

Total Project Budget	**$41,184.**
Total Federal (Title II) Expenditures	**$29,999.**
Total Other Expenditures (Matching Funds)	**$11,185.**

23b. Project Site:
Project administrative activities took place at the Mathematics Education Development Center, School of Education - Suite 309, Indiana University, Bloomington. Workshops took place at Terry's Conference Center in Bloomington. Individual work with Dyer teachers took place at Dyer school.

24. Dates of Project Activities: *Start* **September 1, 1989** *End* **August 31, 1990**

25. Area(s) Served:

Rural/Regional
(Bloomington/Monroe County and surrounding counties)

Narrative Report

26. *Recruitment: Describe recruitment activities and materials (include examples of materials in appendix). Who participated, and how were they selected? Did the project attract the number and type of participants anticipated?*

Overall, project staff were pleased with the number of participants who attended. In the project proposal, we had anticipated a total of 100 participants attending each of the 5 teacher workshops. Although only 30 teachers attended all 5, 158 individuals attended at least one workshop. Thus, while we would have preferred more sustained participation, almost every session was filled to capacity.

Recruitment activities and materials. Original recruiting began at the start of school in August, 1989 when a brochure about the project (see Appendix C) was sent to 79 elementary school principals from schools within a one-hour drive from Bloomington (see Appendix D). We sent directly to principals rather than superintendents because of past experiences where some superintendents failed to notify others in their districts about inservice opportunities. Note that although we considered sending workshop information directly to teachers we decided against that because of difficulties in obtaining teachers' names prior to the start of school and because we felt that teachers who were encouraged to attend by administrators would have more in-school support for implementing teaching suggestions made at the workshops.

In addition to materials sent to principals, a number of participants heard about the project through "word of mouth." Many had participated in a similar project in 1988-89 and contacted the Mathematics Education Development Center (MEDC) in September of 1989 to inquire about additional workshops they could attend. Because the mailing to principals and word of mouth methods of recruiting appeared to be attracting the number and type of participants desired, no further recruiting efforts were made.

Participant selection. The original project proposal specified that the following individuals would be invited: 24 teachers from Dyer School, three teachers (or two teachers and a principal) from each of the other 13 elementary schools in the Monroe County Community School Corporation (MCCSC), 12 teachers from private schools, and 16 from public schools outside MCCSC. A waiting list was generated for each workshop. The list contained teachers who wanted to participate but were beyond the "quota" for their group. One week before each workshop, teachers on the waiting list were admitted if space was available. Any additional spaces were filled with graduate students from Indiana University who expressed interested in attending. Except for the principals only workshop, every session had at least 100 people signed up to attend. Because a number of individuals made reservations for the first three sessions but failed to show up, we "overbooked" the final three sessions to get total attendance of about 100 at each.

As noted in the response to questions fifteen and nineteen, 119 public school teachers, 12 private school teachers, 19 principals, 2 other school administrators, and 6 graduate students attended one or more sessions. In general, we felt we succeeded in attracting the number and type of participants we had anticipated.

27. *Cooperative Planning: Describe role played by school corporations and/or private schools, and by other parties if this was a cooperative project, in identifying needs and devising ways to meet those needs.*

Overall planning of the workshops was done by the project director and co-directors with advice from participants. The advice came from three sources. First of all, we asked participants

in the 1988-89 workshop series for suggestions on how to improve a workshop series if one was funded for the 1989-90 school year. These suggestions were used in developing the original proposal and laying out the initial workshop topics and scheduling. The second source of suggestions was the participants in the first two workshops. Their comments guided organization of the final four sessions. Finally, an informal project advisory board consisting of six teachers from Dyer elementary school gave advice on how to make the workshops as useful as possible for other teachers.

28. *Plan of Operation:*

Summarize the services/instruction and follow-up activities that your project provided.

The major project activity was a set of six workshops on teaching mathematics in the elementary school. The first workshop was for principals only, while the other five were aimed at elementary school teachers. The overall focus of the project was helping teachers to implement the *Curriculum and Evaluation Standards for School Mathematics* outlined by the National Council of Teachers of Mathematics in 1989. Because the *Standards* are too extensive to be covered completely in a series of workshops, each speaker focused on one topic and noted how that topic fit into the general themes underlying the *Standards*.

In addition to the workshops, there was individual follow-up with teachers from Dyer Elementary School in Bloomington. Dyer is the site of mathematics field experiences for preservice teachers at Indiana University and Dyer faculty have been working with faculty from Indiana University for the last two years to implement more conceptually based and problem -solving oriented instruction at the school. While the workshops were intended to provide inservice for a large number of teachers, funding from the National Science Foundation (NSF) made it possible to have greatest follow-up with the Dyer faculty. Additional information on the NSF sponsored project can be found in Appendix A of the original Eisenhower proposal or from MEDC staff.

Keynote Sessions

The six keynote sessions were presented by nationally-known speakers with assistance from project staff. Each ran from 4:00 p.m. to 6:00 p.m. on a weekday. Each speaker provided a set of handouts with activities appropriate for the elementary grades. (Because of the length of the handouts, they have not been included in this report. They are, however, available on request.) Note that although topics presented are ones requested by teachers, a major factor in deciding on topics was the availability of good speakers. Reactions from participants in the 1988-89 workshop series indicated the exact topic was not as important as the ability of the speaker to make the topic interesting, and thus several proposed topics were modified because no high quality speakers were available. Below is a summary of each of the keynote sessions.

<u>September 13, 1989</u>

New Directions for Elementary School Mathematics (session for principals only)	Dr. Paul Trafton National College of Education Evanston, Illinois

What are the goals of mathematics education today? How are they changing and why? How can administrators support teachers' efforts to implement recommendations of the *Standards*? To answer these questions, Dr. Trafton spoke on why the *Standards* were originally proposed and who was involved in writing them. Several "hands-on" mathematics experiments were conducted to help principals see what it means to attack a problem from a problem-solving orientation.

October 17, 1989

Developing Estimation and Mental Arithmetic Skills

Dr. Larry Leutzinger
University of Northern Iowa
Cedar Falls, Iowa

With the introduction of the calculator and computer, estimation and mental arithmetic skills have become increasingly important. Students need to know when an answer looks reasonable and when they should recheck their calculations. Dr. Leutzinger provided activities for estimating distance and area as well as calculations. Other activities focused on place-value, a crucial concept for estimation and mental arithmetic. In addition to activities, Dr. Leutzinger discussed methods of questioning students that make them solve problems in their heads rather than resorting to paper and pencil or calculators.

November 13, 1989

How the Calculator "Figures" in Your Classroom

Dr. Earl Ockenga
Price Laboratory School
University of Northern Iowa
Cedar Falls, Iowa

According to the NCTM *Curriculum and Evaluation Standards*, the calculator issue is not *whether* calculators should be used in the elementary school. The critical question is *when* and *how* they should be used. Dr. Ockenga provided a series of calculator activities designed to help students understand mathematics better. The activities ranged from calculator games designed to help students remember basic facts to problem-solving activities of the type done in Dr. Trafton's workshop. For example, suppose the 6 and 4 keys did not work on the calculator. How could you multiply 694 x 52 using the calculator?

March 1, 1990

Reaching Instructional Goals: Using Learning Centers for Mathematics Instruction and Practice

Ms. Sue Peterson
Gilbert Public Schools
Gilbert, Arizona

With recent national emphasis on cooperative groups as well as individualized instruction in mathematics, use of learning centers has become prevalent in many classrooms. Ms. Peterson's presentation focused on how to construct learning centers that are both interesting and teach worthwhile mathematical topics. While not a "make-it take-it" workshop, participants did have a chance to make a card deck and several other items to be used in several of the centers Ms. Peterson suggested. For example, each card in the card deck had a pair of numbers. Ms. Peterson showed how to use the pairs to look for number combinations. The activity promoted flexible thinking while still giving students practice on basic facts. Variations of the self-checking game were provided for any combination of addition, subtraction, multiplication, or division facts.

March 20, 1990

Active Mathematical Thinking

Ms. Marcy Cook
Elementary Mathematics Specialist
Balboa Island, California

Ms. Cook's presentation focused on techniques for making students active participants in mathematics. She began with a number of ideas for "stumper" questions designed to get students

thinking. For example, using number tiles containing the digits one through ten, make the largest 7-digit odd number with a 9 in the tens place. Her presentation continued with numerous other activities for getting students to think and discuss rather than just memorize mathematics.

April 12, 1990

Integrating Language Arts and and Mathematics Instruction: Building a Base for Problem Solving	Dr. Calvin Irons Brisbane College of Advanced Education Brisbane, Australia

Far too often, mathematics and language arts are taught as if they are completely separate subjects. Dr. Irons spoke on how to use numbers and language together to build mathematics and language arts skills and to help students understand word problems. Much of the presentation focused on using picture books in which numbers were needed to describe the stories. Videotapes of children using the books were also shown with an emphasis on how the children's comments indicated the extent to which they were understanding why number was an important aspect of the stories.

Follow-up Activities

As noted above, the keynote sessions were open to elementary school teachers from public and private schools in the region surrounding Bloomington. Dyer teachers, because of their participation in the NSF sponsored project at Indiana University, received additional follow-up from project staff. The primary delivery system for this follow-up was the placement of a resource teacher at Dyer school. Funded by the NSF project, the teacher spent 20 to 30 hours each week working with individual teachers. After each workshop, the resource teacher met individually with teachers to talk about how suggestions from the workshop speaker could be implemented. On many occasions, the resource teacher visited classrooms to comment on teacher's techniques or to model innovative teaching by running the class herself. Other project staff helped with this follow-up on a limited basis.

Non-Dyer teacher teams who attended the workshops were encouraged to implement the suggestions of the speakers on their own or in cooperation with other teachers in their buildings. While we had not anticipated having more than 3 or 4 teachers from any school except Dyer, some schools sent no teachers and thus nine schools beyond Dyer were able to send 5 or more participants (see Appendix E). A side affect of this clustering of participants in a few schools was that there was peer support for innovation in those schools. Note that although project staff focused their follow-up on Dyer, they did provide consultation and assistance to other schools on request. For example, several teachers wanted suggestions on which manipulative materials to purchase with money provided by their schools. Project staff helped those teachers decide how such funds could best be used.

Note: The rest of the questions relating to "plan of operation" deal in part with the effectiveness of the project. As writers of this report, we felt it would be very difficult to describe the effectiveness of the project without first describing how we measured that effectiveness. Thus the remaining plan of operation questions will be dealt with after question 29 in which we describe the evaluation of the project.

29. *Evaluation: Describe how your project's effectiveness was assessed with respect to participating teachers, participating students, and impacted students.*

Participating teachers: Because teachers and principals were the recipients of the instruction, the major data source for the project evaluation plan was this population. Data from principals are limited because there were five workshops for teachers but only one for principals.

A thorough evaluation report was prepared by an evaluator with no ties to the project (Ms. Sarah Cassell). That report is included in its entirety in Appendix A. A brief overview of that evaluation will be provided here.

Evaluation of participant reaction to the project involved three types of instruments (see Appendix B). The first was a brief evaluation form used at the end of each of the keynote sessions. The forms were constructed by project staff and modeled after forms used in the 1988-89 workshop series. We asked each participant (except Indiana University graduate students) to complete these forms which dealt only with the workshop at which they were used. The second type of instrument was a comprehensive questionnaire which dealt with the first four teacher workshops. Designed by the project evaluator together with project staff, it was sent to anyone who had participated in the those workshops and focused on the extent to which innovations suggested by workshop speakers were being implemented in the classroom. The third type of instrument was a telephone interview. The interviews took place after the final workshop and included questions on how workshop ideas were being shared and implemented in participant's classrooms. The sample for the interviews was the 30 teachers who attended all five of the teacher workshops. The interview questions were designed by the project evaluator together with project staff and interviews were conducted by Indiana University graduate students.

As can be seen in the full evaluation report (Appendix A), the workshop series was interesting, motivating, and quite successful in the eyes of the participants. The principals felt the session they attended was very worthwhile and teachers were excited about the sessions they attended. The last session for teachers received only modest ratings from participants although it appears that the sessions that preceded it were so good that anything less than excellent was probably perceived as a let down. It is encouraging to note that while instilling enthusiasm to teach mathematics was probably the greatest achievement of the workshops, many teachers commented on how much they shared their knowledge with colleagues who did not attend. While there is not a lot of evidence concerning student achievement, teachers were quite explicit about how their enthusiasm for mathematics was rubbing off on students.

Participating students. No students participated in this project and thus there was no evaluation of participating students.

Impacted students. As noted in the response to question 18, at least 3,000 and quite possibly 10,000 or more students were indirectly affected by this project. Obviously, it was not feasible to attempt to measure achievement gains for a group of this size. In addition, given that there were only six workshops, the only noticeable effects on achievement would probably be on those aspects of mathematics discussed during the workshops rather than on overall mathematical achievement. As noted above, teachers were unable to determine exactly how much effect their workshop participation had on their students' achievement but many noted how much more excited their students were about mathematics. Given the *Standards* presumption that *all* students need to gain mathematical confidence and power, this enthusiasm is heartening.

In our original proposal, we had noted that we would include achievement test data on Dyer students in an attempt to determine the impact of the project on them. While we are still collecting and analyzing those data, the task has proven far more difficult and much less useful than originally projected. Difficulty in collecting data stems from two sources. First, many of the families with students at Dyer tend to move frequently and thus the potential pool of students on which data are available for both spring 1989 and spring 1990 is small. Second, parental permission must be received before we can use achievement test data. Many students failed to take consent forms home and when they got there, some parents had difficulty understanding them and thus failed to return them. The major problem with respect to data analysis is that it is hard to make the case that changes in students' achievement over a year can be attributed to these workshops. The extensive follow-up with Dyer teachers includes many activities which went far beyond those

in the workshops and thus there is no way to determine how much of a change in test scores is attributable to workshop related innovations. Related to this problem is the fact that the last three teacher workshops took place in March and April of 1990. In Indiana, standardized testing is done statewide in the second week of March and thus innovative teaching resulting from the last three workshops would have taken place too late to have an influence on test scores. In short, while looking at achievement data from Dyer students seemed like a good idea at the time the proposal was written, it failed to prove useful for evaluating this project. These data may be useful for evaluating the NSF sponsored project taking place at Dyer school. Analyses of Dyer data from 1988 to 1991 will be analyzed and included in the final report of that project late in 1991.

Note: Following are the rest of the questions which were part of the discussion of plan of operation (question 28).

Describe the impact you believe your project has had on participants. What is the evidence that they are using concepts, techniques, materials, activities or information from project activities in their classrooms?

This question was the primary focus of the evaluation report (Appendix A). In brief, the evaluation report indicates that, based on questionnaires completed by participants and follow-up telephone interviews, almost every participant used some of the ideas from the workshops in their classrooms and most participants used many of the ideas presented.

Describe what your project did to address needs of teachers from private schools. What do you know about the effectiveness of those activities?

There are very few private schools in the region served by this project although many telephone contacts were made with those schools to encourage their participation. The original proposal stated that 12 spaces would be reserved for private school teachers. We did have 12 in attendance (see Appendix E) although we would have taken others had there been more interest. Given that private school teachers made up less than 10% of the population served, and that the private school participants indicated verbally that they did not need special attention, no special attempts were made to cater to their interests. The external evaluator considered the needs of private school participants when the questionnaires and telephone interviews were analyzed and found that they were just as happy with the workshops as public school teachers (see Appendix A). In other words, private school teachers felt their needs were met by the project.

Describe what your project did to address needs of underserved/under-represented students (students who were minority or female, students with limited English proficiency, handicapped students, migrant students). What do you know about the effectiveness of those activities?

A key theme of the NCTM *Standards* on which this project was based is that mathematics is important for all students. Speakers continually noted this, along with the notion that all students are *able* to learn mathematics. There were not, however, any special sessions on the needs of underserved/under-represented students. Poverty and lack of parental support is certainly an issue in many of the schools the participants represented and thus working in such schools was discussed by some of the speakers. Because the area served by the project has very few minority students, there were no special discussions on working with minority children.

Describe what your project did to address needs of gifted and talented students. What do you know about the effectiveness of those activities?

None of the workshops dealt specifically with gifted and talented students. However, many of the topics of the workshops (problem solving, estimation, supplemental learning centers,

active thinking, etc.) are ones traditionally associated with programs for gifted and talented students. Special needs of gifted and talented students were not part of the evaluation report although, given the overwhelming participant satisfaction with the project, it seems reasonable to assume that teachers were given a sufficient amount of advice on how to deal with this population.

Describe what your project did to address needs of minority teachers; teachers of underserved/underrepresented students; teachers of low income students or students from sparsely populated areas. What do you know about the effectiveness of those activities?

Again, the extremely low incidence of minority teachers and students in the area served made special programs on working with underserved students seem unnecessary. Although not a specific focus of any one workshop, techniques for students with weak home support for education were often addressed. All speakers noted both the importance and the effectiveness of problem solving and critical thinking activities for poorly motivated and/or low achieving students. Other examples include number cube games for teaching facts (workshop 3), learning centers for low achievers (workshop 4), number tile games for teaching place value (workshop 5), and strengthening weak language and math skills concurrently through number stories (workshop 6). In brief, each of the speakers was able to provide some activities for weak learners and additional activities for strong learners. Although evaluation data are not specific on the effectiveness of such activities for low income students, a number of teachers commented how easily they could use workshop activities with the types of students they had in their classes (Appendix A).

30. *Dissemination: What efforts have been made to publicize your project or to call other teacher's attention to its accomplishments? Describe what has already taken place and what is scheduled: Press releases, presentations, participants' inservice for their peers, publications, etc.*

Initial publicity for the workshops consisted of a letter and flyers sent to each principal of an elementary school in the area around Monroe County inviting them to enroll teams of teachers from their schools. The workshops were also publicized via articles in the *IU Mathematics Education Development Center Newsletter*. Three issues of this publication, which describes numerous activities of the Center, were distributed during 1989-90 to mathematics educators from around the country, to various education faculty and administrators from Indiana colleges and universities, to IU School of Education faculty and administrators, and to all principals and teachers involved in the workshops. Four of the five teacher workshops were publicized to all teachers in the Monroe County Community School Corporation through the Corporation's booklet describing activities available for credit under the district's required inservice program, *PIVOT* (Planned Inservice Variables with Optional Timing). (Only inservice activities that have been approved by the district and that are held within the *PIVOT* time periods -- which, during 1989-90, were September 25 to October 27 and February 20 to April 27 -- are eligible to be included in the PIVOT brochure. An effort was made to plan as many of the project's workshops within these time periods as possible.) Numerous teachers reported during the final evaluation of the project that they had used what they had learned in the workshops to put on inservice workshops for their peers, but we have no specific information concerning how these workshops were publicized. A brief overview of this final report will be sent to all school districts in the state, and copies of the entire report made available to those who request it. This final report is also being submitted to the ERIC Document Reproduction Service so that the entire description of the project can be made available to interested educators throughout the nation.

31. *Lessons Learned: What were the strengths and weaknesses of what you did, or sought to do? What advice do you have for future Eisenhower project guidelines or future project staff?*

Strengths and weaknesses. The greatest strength of this project was its ability to get a large

number of teachers and principals excited about teaching mathematics. In past projects of this type, a dynamic speaker was often viewed as just as important as the content being presented. The workshops were not lectures, but they were much more than "make-it take-it" workshops. General ideas with specific applications to the classroom were presented. Participants felt this format served their interests well.

If there was a weakness in the project, it was that we do not know that much about how teachers' excitement translated into change in the classroom. Documenting such change is extremely difficult on a limited budget. There is evidence from other projects that without direct follow-up, workshops have little long term effect. Our data indicate that teachers changed with support from each other rather than project staff and thus this potential weakness did not seem to materialize.

"Advice" for future project directors:

The conclusions and recommendations portion of the evaluation report (Appendix A) includes a number of suggestions from the project evaluator. The following recommendations are from the project director and co-directors.

- *Large scale "one shot" workshops can be effective if the topics are important, the speakers are motivating, and the participants have support from their peers.*
  The effectiveness of the "one shot" model has often been questioned with respect to actually getting teachers to change. Intuitively, it makes sense that follow-up from workshop staff is better than no follow up. However, our data indicate that when limited resources prevent extensive follow-up, dynamic speakers are able to get teachers to change they way they teach mathematics.

- *Organizational aspects of a project of this type are quite time consuming.*
  Although our previous experiences with projects of this type made it clear that organizing would take a lot of time, we feel obligated to warn prospective project directors that organizing a project of this scope is difficult. Seemingly simple things like arranging catering or finding a date when no other meetings are scheduled can take hours if not days. New participants will be continually asking to attend or for information on workshops they missed. If you have advance registration, assume some people will fail to read directions and show up "unannounced." Assume that when you order materials, the one piece of equipment you need most will be "back ordered" and unavailable when you need it. In short, when planning a project, double or triple what seems to be a reasonable amount of organizational time.

- *Expect that some preregistered participants will fail to attend.*
  It is not clear to us why someone would call the day before a workshop and beg to be admitted but then fail to show up when admission was granted. Things like this happened a number of times and thus we began "overbooking" to assure that each session was filled. While we would have had problems if all of those preregistered actually attended, this never happened.

- *Participant motivation is an important, uncontrollable variable in the success of a project of this type.*
  We believe that a key to the success of this project was that teachers who attended did so because they wanted to get better. Our experience with such teachers is that a workshop that gets them excited is all that is really necessary to help them change. However, we have also worked with teachers who had little interest in changing anything they were doing. Although these teachers usually need inservice the most, providing *effective* inservice programs for them can be very difficult.

- *Recruiting participants can be difficult.*
  Because the staff for this project had been involved in a number of other projects, there was a fair amount of interest from previous participants when we started this project. Without that track record, however, it would have been difficult to attract participants. Of the schools we invited but had not worked with before, 80% failed to indicate interest.

- *Teachers appreciate being treated as professionals.*
  It is sad to say that budget restraints have made most teachers expect inservice to be provided on a "shoestring" budget. Having a pleasant meeting site, ample parking, snacks, and colorful take-home materials made teachers feel appreciated and helped to get them excited about teaching using new techniques. We received many complements about the professional way these workshops were organized and the professional way the teachers were treated.

- *Representatives of the participant group should have input into workshop topics.*
  Although most of our recommendations deal with organizational rather than content issues, content is a crucial aspect of a successful workshop series. Before inviting speakers, we received input from prospective participants on topics they felt would be important. Several potential topics were dismissed because of lack of interest. Even though we cannot say for sure that those topics would have been poorly received, our belief is that they would not have been as meaningful as those on which there was considerable interest.

"Advice" for writers of future Eisenhower project guidelines:

Overall, the Indiana guidelines for Eisenhower projects appear to fit both federal regulations and the needs of students and teachers in Indiana. Thus, points mentioned below are intended as suggestions for "fine tuning" the project approval process.

- *Attracting participants may be getting easier than it was several years ago.*
  Local, state, and national emphasis on mathematics and science teaching have helped to make teachers and school administrators much more receptive to new ideas for teaching these subjects. Data from our evaluation report (Appendix A) indicate most participants were already trying to make improvements in mathematics teaching and thus were eager to participate in the workshops. We rarely heard such comments a few years ago.

- *Be careful that projects are not spread across too many schools.*
  Although it is good to have projects that reach a large population, many teachers need peer support for change. Our most consistent participants were ones who came to the workshops with one or more friends and then worked with those friends to implement speakers' ideas. Even though having many teachers from one school limits the area a project can serve, it seems to increase the odds that the project will be effective in the schools that are served.

- *Look for evaluation procedures that will provide meaningful evaluation data.*
  Given the limited funds available for Eisenhower projects, it is probably not possible to adequately evaluate the effectiveness of large-scale projects *on students*. Although we feel student achievement is very important, the number of variables that affect achievement is so large that evaluating the impact of a specific project on achievement is beyond available resources when more than a few classes of students are involved. Thus, rather than asking project directors to try to measure changes in student achievement, look at teacher reactions and changes. When evaluating proposals, look for projects that make sense in terms of the objectives stated rather than for proposals that have complex plans for evaluating the extent to which easily measured, but questionably important, objectives are met.

- *Having a variety of staff members is an asset if the staff work together as a group.* The extent to which staff will work together effectively in any project is hard to determine from a proposal. A comment from an evaluation of previous Eisenhower-type projects was that having too many staff often caused lack of focus in a project. We had a director and 5 co-directors providing input and found the diversity of opinions was a real strength when considering various options. It should be pointed out, however, that we (the project staff) had worked together on a number of projects and thus knew that we could count on each other to share and effectively complete the many tasks that go into a project of this nature. We also knew each other well enough to know that we were in agreement on the message to be conveyed to participants.

Summary

It has been the intent of this final report to describe what took place in the inservice project *Implementing the NCTM Standards for School Mathematics for the 21st Century*. The format for the project was a series of workshops, one for principals and five for teachers. A nationally known speaker was provided for each workshop. The speaker was supported by staff from the Mathematics Education Development Center at Indiana University. In addition to the workshops, teachers at one school were given extensive individual follow-up if they requested it. There is little question that the group with extensive follow-up made the greatest changes. What is surprising, however, is how much some of those who had no follow-up from project staff were able to change. The most important variable determining the extent to which teachers changed was individual teacher motivation to improve. For those who wanted to do better, the workshops provided the catalyst to get them going. It is probable that those who did not care did not attend the workshops in the first place. In other words, workshops combined with extensive follow-up can assure change in almost any teacher. There are many teachers, however, who can and do improve with a minimum of support beyond their peers. Data to support these claims can be found in the project evaluation report (Appendix A).

Appendix A:

Evaluation Report for

Implementing the NCTM Standards for School Mathematics in the 21st Century

Prepared by
Sarah Cassell

July 22, 1990

Summary

The purposes of the evaluation report are: 1) to report the effects of the project on the participating teachers, principals and impacted students, 2) to report the extent to which the project's objectives were achieved, 3) to offer judgments about the strengths and weaknesses of the project, and 4) to supply recommendations for planning future projects with similar goals and audiences. With very few qualifications, the inservice series, "Implementing the NCTM Standards for School Mathematics in the 21st Century," was a success. The participants responded with interest and enthusiasm to excellent presentations on new teaching methods by national experts in elementary mathematics education. During the project period, the participants worked actively to implement the methods in their classrooms and share their workshop experiences with their colleagues. They were pleased with the results of their efforts and are eager to continue the implementation process.

Evaluation Focus

As stated in the project proposal, this project was designed to improve the teaching of mathematics in the elementary school. The intended improvements were based on the 1989 NCTM *Curriculum and Evaluation Standards for School Mathematics*. The proposal asserted that achieving such improvements would require certain changes in the attitudes and behaviors of teachers. As a result of these changes, teachers would put less emphasis on teaching computational skills and more emphasis on teaching higher-order thinking processes such as problem solving, reasoning and number sense. The proposal stated, further, that future improvements in mathematics education would require increasing the general adaptability of teachers to change. The project designers proposed to progress toward these goals by organizing and hosting an area inservice education program for teachers of grades K through 6.

The proposal's central focus--teacher attitudes and behaviors--generated the central project evaluation questions: Has the project effected changes in the attitudes and behaviors of the participating teachers? If so, what are the changes and how were they brought about?

Project Objectives

Thirteen specific project objectives were stated in the proposal. In the interests of brevity, they have been summarized here in seven objectives. The evaluation method was based on determining the extent to which these objectives have been accomplished. Each objective was addressed in specific evaluation instruments and data sources.

Objectives for Participating Principals

For the participating principals, the objectives were: 1) to be able to explain the major recommendations for change in elementary school mathematics as presented in the NCTM *Standards for School Mathematics*, and 2) to help implement the *Standards* by supporting teachers in their attempts to adopt the changes suggested by the *Standards*.

The achievement of these objectives was measured according to the following criteria:

1. attendance at the principal's workshop,
2. expressed positive attitudes toward the project goals,
3. demonstrated knowledge of the content and significance of the *Standards*,
4. encouragement of teachers to attend workshops, and
5. demonstrated support of teacher efforts to change, e.g., providing money for new materials, scheduling additional preparation time and organizing building inservices.

Objectives for Participating Teachers

For the participating teachers, the objectives were: 1) to be able to explain the major recommendations for change in elementary school mathematics as presented in the NCTM *Standards for School Mathematics* and 2) to adopt teaching methods which a) develop their students' mathematical skills in reasoning, estimation, understanding, number sense and mental computation, and b) utilize manipulatives to teach mathematical concepts.

The achievement of these objectives was measured according to the following criteria:

1. attendance at the workshops,
2. expressed positive attitudes toward the project goals,
3. demonstrated knowledge of the content and significance of the Standards,
4. demonstrated knowledge of the content presented in workshops attended,
5. reported efforts to implement the workshop ideas and techniques, and
6. expressed positive attitudes toward continuing the implementation of the workshop ideas and techniques.

Objectives for Educators and School Officials throughout Indiana

For educators and school officials who administer and support educational improvement programs throughout Indiana, the objectives were that the project would 1) provide an inservice program model for projects with similar goals and audiences, 2) report the effectiveness of using national experts as workshop presenters and 3) report the effectiveness of minimal follow-up to teacher inservices. This project final report is intended as the vehicle to meet these three objectives.

Evaluation Method

An assumption behind the teacher workshops model of inservice is that teachers are the primary agents of change. Their attitudes and behaviors are critically important to the success of the program. Principals are regarded as supporters of and facilitators for teachers during the change process. The methods and instruments of this evaluation were designed to analyze the project in these terms.

Given the limited resources for evaluation of the project, this evaluation was designed to include the widest possible cost-effective sampling of the project participants. The survey items were designed according to the project objectives. Evaluation criteria were referenced to the objectives. Interpretations of data were based on categories, themes, relationships and trends which emerged from the data. Although frequency of response was an important factor in data analysis and is always reported, noteworthy minority views were also considered valuable and thus are also reported.

The Evaluation Instruments

The Post-Workshop Questionnaires: At the conclusion of each of the six workshops, participants received questionnaires which they were asked to complete before leaving the site (see Appendix B). The questionnaires provided opportunities for the participants to respond immediately and anonymously to questions about the quality and content of the workshop they had just attended. The questionnaires also elicited information about the participants' current teaching methods, preferences, instructional resources, concerns, needs, feelings and intentions.

The Comprehensive Workshop Series Questionnaire: In April 1990, a week before the sixth and final workshop, the teachers who had signed up to attend the last workshop received in the

mail a comprehensive workshop series questionnaire (see Appendix B). This questionnaire elicited responses on the quality, content and effectiveness of the workshops as a whole. Specific questions were asked to determine whether the participants had changed their approach to mathematics teaching as a result of the workshops. They were asked to identify the obstacles they had encountered in attempting to implement the new methods. There were also questions about the first four of the five teachers' workshops. Responses here provided some follow-up information on the longer-term effectiveness of the workshops.

The comprehensive questionnaire was distributed by mail before the last workshop because a higher response rate could be anticipated if teachers were instructed to bring the questionnaires with them to the final workshop. Most teachers turned in their completed forms when they arrived at the last workshop, although a few others mailed them in later. The disadvantage of mailing out the questionnaires before the last workshop was, of course, that feedback on the sixth workshop could not be included in the comprehensive questionnaire. Evaluation data on that workshop is limited to the post-workshop questionnaire and the telephone interviews.

The Telephone Interviews: A few weeks after the last workshop, telephone interviews were conducted with the teachers who had attended all five of the teachers' workshops (see Appendix B). The interview method was flexible in order to obtain candid feedback. Questions were asked about understanding, utilization, attitudes, instructional outcomes and professional support.

The Strengths and Limitations of the Evaluation Method

The evaluation instruments provided abundant data on the participants' attitudes toward the project goals for the implementation of *Standards*-based changes in mathematics education. This was a very responsive, candid group of participants. There are plenty of data on the quality and content of the workshops and the effectiveness of the speakers. There is also a good deal of information about the utility of the ideas and techniques presented, the degree of local support for implementation, and the barriers to change. The evaluation is limited in that most of the data were obtained by self-report, there is no objective data on instructional outcomes and there is minimal information about the long-term effectiveness of the project. The data can tell us a lot about the teachers' levels of awareness, interest, enthusiasm, activity, comfort, confidence and intentions. They cannot tell us much about the teachers' competence in carrying out the recommended changes.

Evaluation Results: The Individual Workshops

Workshop #1

Implementing the NCTM Standards for School Mathematics for the 21st Century
Presentation for **Principals** by Paul Trafton, September 13, 1989

"This topic is timely and workshops like this must continue."

"Interesting workshop that is desperately needed."

The questionnaire responses of the participants at the workshop for principals were consistently positive about all aspects of the presentation. There were 19 principals present at the workshop. Eighteen filled out the post-workshop questionnaire--a 95% response rate. The average response to the six evaluation items on the five-point value scale was 4.75. All eighteen respondents thought the workshop topic was extremely important (5) and the overall quality of the session was quite high (4.55). Their evaluations of the speaker's knowledge (4.95), preparation (4.85), interest and enthusiasm (4.75) were also very high. Most of the principals felt they would

implement some of the ideas presented during the session (4.4).

All of the participants had heard of the NCTM *Standards* prior to the workshop, but only three had actually read the *Standards* or heard a presentation about them. The other fifteen had only limited familiarity with the *Standards* and had, consequently, the most to gain from the workshop.

The principals' comments on the questionnaire reflected concerns and goals much like those of the inservice project itself. Although we do not know the extent to which their attitudes were affected by this workshop alone, it was clearly evident that, by the end of the session, these principals had become convinced of the value of the approach to mathematics education as promoted by the project. "I consider math the area that needs the most help." "A workshop on every standard would be helpful."

The principals believed mathematics instruction must move away from "the old paradigms" which focus on the textbook, drill and "busy-work." They favored "a more problem-solving approach"--relevant to practical daily life and involving active mathematical understanding. They thought that the means to bring about this change were good materials, teacher inservice training and follow-up, and administrative support. They emphasized that changing the attitudes of teachers and parents toward mathematics education was a prerequisite to changing mathematics education at their schools.

Several principals, stressing the value of workshops like this, requested there be more of them. One volunteered to host a workshop in Johnson County. Another suggested organizing a group discussion with other school corporations to share ideas on math education. The principals appreciated the workshop and, at least in words, supported the project objectives. "This was great! I'd like to attend more." "Keep up the good work." "Good luck with our cause."

Workshop #2

Promoting Estimation and Mental Arithmetic Skills
by Larry Leutzinger, October 17, 1989

"The answer is not important, but the thinking involved is most important!"

"I NEED TO DO THIS and I will!"

This was one of the two most highly rated workshops in the series. Seventy-eight teachers, 2 tutors, and one administrator were given questionnaires. Sixty-five were completed, yielding an 80% response rate. The average score for the six items on the five-point value scale was 4.88. The participants thought that the topic was extremely important (4.97) and that the overall quality of the session was very high (4.9). Most participants predicted that they would utilize the concepts presented (4.57). They found the workshop very well organized (4.9) and the speaker's knowledge (4.99), interest and enthusiasm (4.96) top rate. There was much praise for the presenter, the only "criticism" being the wish that the workshop had been longer.

Many teachers commented that the workshop's greatest value was that it taught them practical teaching techniques for increasing their students' mental math and estimation skills. They felt they had learned specific, useful activities which they were "eager to try" in their classrooms. Many teachers said that they planned to use the workshop activities every day. The teachers also remarked on how effectively they thought the activities would develop complex thinking skills. Several felt the workshop had provided them with links between the theory of these skills and its application to instruction.

Six months after this workshop was given, the participants were asked to complete the comprehensive questionnaire for the workshop series. This questionnaire provided follow-up information on 65% of the teachers who had attended the second workshop. It is evident from their responses in April that they still felt enthusiastic about what they had learned at the workshop in October. Many teachers reported that they were using mental math activities frequently in their classes. Several reported daily or several-times-daily use. They said that mental math adapted well to their teaching needs and helped them "make the most of spare moments." "I use these ideas whenever we have a free minute."

Some teachers reported that the techniques had improved their students' math skills. "At first my students were way off in their estimations, but they are learning to calculate more efficiently." A couple of teachers mentioned that the techniques were "good preparation for ISTEP tests." Mental math activities had helped some teachers identify student learning difficulties. "Very effective in indicating problem areas."

Mental math had also, apparently, increased student motivation and confidence. Many enthusiastic teachers appreciated their students' new enthusiasm for mathematics. "The children were frustrated at first, but love it now." "The children love the mental math quizzes." "Students are much more confident in their math abilities." "They love it!"

The handouts and materials that the teachers received at the workshop were rated very highly (4.42 on a 5-point value scale) and were shared with many teachers who had not attended the workshop. By the participants' reports, a lot of sharing was done--of the handouts, activities, ideas and philosophy presented at the workshop. A minimal estimate of the number of other teachers who received this information was 155. On average, each participant reported sharing the workshop ideas and techniques with three other teachers.

Workshop #3

How the Calculator "Figures" in Your Classroom
by Earl Ockenga, November 13, 1989

"No access to calculators!"

"I was taught that calculators would prevent learning of math facts. How erroneous!"

Of the 64 teachers at this workshop, 60 completed the post-workshop questionnaire, yielding a response rate of 94%. Although the topic of this workshop was the least familiar of the series topics to the participants, the workshop was very well-received. On the post-workshop questionnaire, the average response to the six evaluation items on the five-point value scale was 4.71. The overall quality of the session (4.85) and the organization of the workshop (4.88) were rated high. A few participants mentioned seating and visibility difficulties at the workshop.

The most positive response was to the presenter himself. He was given a unanimous highest-possible rating for knowledge of content (5). This was the highest among all workshop presenters in the series. His rating for interest and enthusiasm (4.9) was also excellent. The only reported problem with the presenter was that his presentation was too fast for some participants. The participants' lack of familiarity with the topic may have been a factor here.

The participants thought that the session's topic was quite important (4.66), yet this evaluation was slightly below the workshop series average for this item (4.74). Correspondingly, the participants had relatively less expectation of utilizing the workshop concepts. The average

response to the utilization item was 3.98 for this workshop (still quite high), whereas the average response for this item in the other workshops was 4.22.

The questionnaire responses indicate that most of the teachers had limited, if any, access to calculators as instructional tools and little, if any, background in how to use them for instruction. Sixty-seven percent of the teachers said they "almost never" use calculators. Another fifteen percent use them "a few times a year." It is reasonable to conclude that they were less prepared for this workshop than they were for the others and that, even after the workshop, they expected to have few opportunities to implement these instructional strategies.

The most frequently stated reasons, by far, for not using calculators in instruction were that calculators were unavailable (33.3%) or under supplied (38.3%). A few teachers said they didn't use calculators because they "didn't know what to do with them." Others said that they hadn't realized "until this workshop" what the educational value of calculators was. The few who reported frequent calculator use cited variety, skill development and reinforcement, problem solving, and fun as reasons.

Despite the obstacles to implementation that these teachers expected to have, they wrote that they had learned valuable lessons from the workshop. They said that they had heard a variety of useful applications for calculators in the classroom which offer a fun, motivating way to learn. They also thought that using calculators could develop their students' skills in computation, thinking, and understanding.

Forty-five teachers who had attended the November workshop completed the comprehensive series questionnaire in April, yielding a follow-up response rate of 70%. The later responses to the workshop were not as whole-heartedly positive as the immediate responses had been. Although these teachers praised the workshop itself, most of them, whether by choice or the force of circumstances, did not utilize during the subsequent months what they had learned at the workshop. Most teachers reported that they had not yet used any of the workshop ideas or techniques or had made only minor attempts to do so. Most of these teachers explained that this was because classroom calculators were not available to them. A few others gave other reasons: insufficient time, not enough appropriate activities and students who were too young to learn with calculators. A few teachers said that their schools had recently purchased calculators and that they intended to use them in their classes. Others were "still waiting" for them. (*Editor's note*: Using materials funds from the project, classroom sets of calculators were distributed in September 1990 to all schools who had at least one teacher attend three or more workshops. Now that calculators are available in these schools, it is probable that more teachers will use them.)

About a dozen teachers reported that they were using the workshop ideas and techniques and were seeing positive results. Their students were enjoying using this "thinking/learning tool." "They especially love checking their accuracy on computation and story problems." "The kids loved them!" Greater teacher confidence and comfort with calculators was also evident. "I have felt more confident that this use is OK." "I felt more comfortable using calculators."

A few teachers were still not convinced that calculators provided good instructional opportunities. "The students enjoy working with calculators, but I question if they really think what they're doing." Although calculators have been around for a long time, using them to teach math is still, apparently, "a new idea" for some teachers, and there is some evidence of resistance to the idea among a few teachers.

As would be expected from these comments, the response to the handouts, although positive (3.8), was not as enthusiastic as was the response to the handouts at the other workshops (4.47 average). Correspondingly, the rate at which they shared their workshop experience with other teachers (1.66 contacts per participant) was lower than the average rate for the other workshops

(2.51). Several teachers, however, reported that they had done a great deal of sharing. Ten teachers said they had presented the workshop ideas at inservices in their schools. Others reported sharing handouts, ideas, activities, games and calculator materials they had made. Two especially noteworthy instances of sharing were described: "Some parents felt negatively until I explained how it works." "All my enthusiasm caused other teachers to attend the next workshops."

Workshop #4

Reaching Instructional Goals:
Using Learning Centers for Mathematics Instruction and Practice
by Sue Peterson, March 1, 1990

"How easy it really is to put a learning center together!"

"I can make math interesting!"

This was the most popular workshop of the series. The participants gave the session and the speaker very high ratings in every evaluation category on the 5-point value scale of the post-workshop questionnaire. Of the 91 attending teachers, 77 filled out the questionnaire, yielding an 85% response rate. The importance of the topic, the organization and quality of the session, and the knowledge, interest and enthusiasm of the speaker were all rated at 4.9 or higher. In the teachers' comments, the high praise Sue Peterson received was unanimous. "She was great, outstanding!" "Perfection!" "I loved her!" The instructional utility of the workshop concepts was rated the highest of the series (4.60). The average response to this item for the other four teachers' workshops was 4.06.

The workshop topic was not new to this audience. Eighty-six percent of the teachers said they already used learning centers to teach any subject at least a few times a year. Half the audience used them at least several times a month; a quarter used them daily. For mathematics instruction, 79% reported using learning centers at least a few times a year; 45%, at least several times a month; and 16%, daily. These figures, combined with the teachers' comments, indicate that the audience was quite familiar with the topic and already trying the learning-center method. "Reaffirmed my belief in learning centers." "Reiterated what I think."

Building on these positive initial attitudes, the workshop presented a great number and variety of learning center activities and materials that the teachers felt would be easy to implement in their own classrooms. The session had a "how to", "can do" message that the teachers relished. It stimulated their enthusiasm most by giving them easy, practical means to implement the workshop concepts on their own. "How easy to do!" "Lots of easily made things." "How easily great learning centers can be put together!" "Tremendous quick ideas!"

They also believed strongly in the instructional and motivational values of learning centers. "To make basics come alive." "Use learning centers to enrich and maintain skills." "How important the fun part of learning is!"

In explaining why they didn't use learning centers more often, the teachers cited lack of sufficient preparation time, problems with scheduling and space, lack of materials and organizational or management difficulties. The workshop made learning centers much more feasible for the teachers with these concerns. They left the workshop feeling eager to try what they thought were excellent ideas and confident that they could succeed in their attempts. "This was great. It definitely sparked my interest. I definitely want to try these ideas." "Just do it!"

A month and a half after this workshop, 63 of those who had attended it filled out the

comprehensive workshop series questionnaire--a 69% follow-up response rate. Many teachers reported that they had tried the workshop methods in their classrooms; everyone who had done so reported success. "I've made many and the kids love them." "The simple but effective ways to teach were very appropriate and easy to implement." "A great way to get to those children that have difficulty."

With only one exception ("Not enthused about learning centers.") the teachers who had not tried the methods since attending the workshop gave lack of time as the reason and said they still intended to include the workshop methods in their teaching. It could be that their schedules are so full that even "quick, easy" techniques take more preparation time than they have.

The teachers rated this workshop's handouts and materials higher (4.7) than those from the other workshops were rated (average, 4.17). The handouts were used extensively in sharing the workshop experience with other teachers. The participants reported sharing games, activities, ideas and materials with at least 166 other teachers, yielding a contact rate of 2.6 teachers per workshop participant--slightly higher than the 2.19 average for the other workshops.

Workshop #5

Active Mathematical Thinking: Keep Their Minds in Motion
by Marcy Cook, March 20, 1990

"Think, think, think creativeness."

"High interest, motivating activities--I'll use them!"

Most of the post-workshop questionnaires were full of very positive reactions to this workshop. Of the 92 teachers who attended, 76 filled out the questionnaire, yielding an 83% response rate. On the 5-point value scale, all evaluation items received high ratings: 4.87 for topic importance, 4.77 for session quality, 4.8 for workshop organization, 4.97 for speaker's knowledge, 4.83 for speaker's interest and enthusiasm and 4.46 for predicted utilization of the workshop concepts. The speaker received a lot of praise for the quality of her presentation and the abundance of useful ideas she presented. A few teachers, however, felt that she had "talked down" to them. A few others thought that the microphone had been too loud. A couple of teachers wished that the ideas presented by the speaker and in the booklets had been specifically related to the grade levels they taught.

According to the teachers' comments, the most valuable lessons from the workshop were the specific techniques the teachers could use to keep their students mentally active with math. They appreciated the number and variety of enjoyable activities to try out in their classrooms. They also liked the fact that the methods would enable each student to be an active, involved participant in the lessons. "How to give everyone the opportunity to participate." "Emphasis on student involvement with math."

The apparent favorite among the many activities presented was the number tiles. "I like the tile idea!" "Use of tiles is really great for all-pupil response." They believed that mental math activities would increase the quantity and quality of their students' thinking. "Sources to use to get kids thinking." "Feeling comfortable with math by using what you know to solve problems." They expected the activities to be especially motivating additions to their teaching repertoires. "Ways to get all children involved, responding, excited about math." "Practical, stimulating ideas."

There was a 79% follow-up response rate on these participants on the comprehensive

workshop series questionnaire. The teachers were asked to fill out the questionnaire only a few weeks after they had attended this workshop. It is not possible, therefore, to draw conclusions here about the workshop's long-term effects. However, many teachers reported that they had begun using Marcy Cook's ideas and techniques immediately after the workshop and that their students were enjoying them. "Immediately bought tiles to use with students in many activities--those suggested as well as some of my own." "I use the math tiles at least once a week. These are excellent." "The kids adopted them instantly and ask for them daily." One teacher reported that her teaching had been significantly changed by her workshop experience: "This workshop changed the organization of my classes." Many teachers commented on the fun and stimulation these techniques provided. There are no comments, however, on any instructional outcomes resulting from their application. At this point, it was probably too early to expect noticeable results in math skills competence.

The teachers rated the workshop handouts and materials high (4.3). These were copied and shared with colleagues. Several teachers reported that they had liked the workshop materials so much that they bought or ordered more of Cook's materials displayed at the session. On average, each teacher shared workshop information with 2.8 other teachers. Most of the sharing involved the handouts, booklets, tile activities, stumpers, the hundred's chart and other hands-on mental math activities. One teacher reported giving mental math presentations at two faculty meetings at her school.

Workshop #6

Integrating Language Arts and Mathematics Instruction:
Building a Base for Problem Solving
by Dr. Calvin Irons, April 12, 1990

"Take everything from the environment and turn it into math--it is everywhere!"

"How to integrate math with language."

Although this workshop received moderately good ratings and brought several positive comments from the participants, it was not as enthusiastically received as the previous workshops had been. It may have suffered in the comparison. More than half of the teachers present had attended at least one of the other workshops and may have come to this one with extremely high expectations. Several teachers expressed disappointment in their comments. "Speaker was good, but did not compare with earlier workshops." "Cal's workshop was frustrating. I had a hard time drawing usable items from it." Nevertheless, the workshop did receive some good ratings and reviews on the post-workshop questionnaire. Of the 76 teachers who attended, 53 completed the questionnaire, yielding a 70% response rate. The participants rated the importance of the session topic at 4.3 on the 5-point value scale, and the organization of the workshop was rated at 4.0. Although the speaker was given a very good rating for knowledge of content (4.6), the rating was the lowest for this item in the workshop series. The average for the other teachers' workshops was 4.98. The rating he received for interest and enthusiasm (3.67), while still positive, was considerably lower than the average for this item in the workshop series (4.9). On the overall quality of the session, this workshop was rated 3.0. The average for the other four teachers' workshops was 4.85. The questionnaire item that asked teachers to predict whether they would utilize the workshop concepts was rated 3.25. For the other workshops, the average was 4.4.

Despite this relatively lukewarm response, the teachers commented that they had learned valuable things at the workshop. Many teachers said they had learned the importance of verbalizing math--combining math and language in instruction. A few mentioned the value of building lessons on the child's natural language. "Model the child's language--mathematical

language and their symbols." "Let the children write their own problems." Several teachers commented that they liked the books and stories that had been presented during the session.

The teachers were quite specific in their suggestions for how the presentation could have been more effective. Several commented that the methods were more appropriate for the primary grades than for the upper elementary grades. "Didn't apply to my level." "He should have addressed upper grade activities as well." The speaker's presentation style was found ineffective by several teachers. They thought he lectured too much and didn't get the audience involved. A few teachers wanted more emphasis put on practical applications and less on theory. The video following the speaker's presentation was considered a repetition of the lecture. The handouts were found inadequate, too. "I was expecting really practical ideas and good handouts. Too much lecture, theory--handouts not very useful." "Video repeated what he said." Utilizing the methods required obtaining the expensive books he was presenting. "He was using specific books and we couldn't buy them."

Though they were in the minority, a few teachers praised the workshop. "He was knowledgeable and enthusiastic. He conveyed his ideas with many visuals." "Excellent seminar." Primary grade teachers, apparently, enjoyed it the most. "Was very good for lower grades."

Evaluation Results: The Comprehensive Questionnaire

"I got fired up!"

"I am seeing a strengthening of my math program."

(Although the comprehensive questionnaire included items on the individual workshops, these data are not discussed in this section of the report because they are covered in the preceding evaluation of the individual workshops.) Of the 130 teachers who had the opportunity to fill out the comprehensive questionnaire, 80 teachers submitted completed forms--a 61% response rate. To the question of whether attending the workshops had been professionally beneficial, 89% responded affirmatively, 7% responded ambiguously and 4% did not respond. In explaining their responses, the teachers commented that they had liked the innovativeness of the ideas presented in the workshops and that the presentations had brought them up to date on the new directions in math education. "Fresh ideas to explore." "Helped me to see new goals for math." "They provided numerous ways for me to update my math curriculum." Many teachers said that the series had been motivating, inspiring, enthusing and revitalizing--for them and for their students. "My enthusiasm for math has increased and, therefore, so has my students'." "It's great to learn the new and have the old revitalized." "I felt inspired to try new things." They especially appreciated the hands-on practicality of the instructional techniques they learned at the sessions and had found the techniques easy to use immediately and valuable additions to their instructional repertoires. "Practical, reasonable, relevant, useful information and activities." "Easy to apply to my classroom." They remarked on the high quality of the speakers and the variety and abundance of ideas and techniques they presented. "I was glad to have the opportunity to hear top people in the math field. It helped me understand how to prepare my students for the future."

The questionnaire asked the teachers whether they saw a difference between the approach to math teaching presented in the series and that which they were accustomed to using. Several teachers responded that there was no difference or that the approaches were similar, but that the workshops had given them more ideas and materials to use with the approach and had supported them in their decision to teach this way. "I am accustomed to using manipulatives and this gave me more ideas to use." "No difference, but I incorporated more into my classroom." (Nearly half of the respondents had attended at least one of the workshops in the 1988-89 series. For them, the approach presented this year would probably not have seemed new.) Many teachers mentioned

that the series approach to teaching was much more "hands-on" than what they were accustomed to. Other differences cited were a greater diversity of instructional strategies, a greater emphasis on higher-order thinking processes, more student involvement, more real-world applications and more fun with math. Many teachers mentioned the emphasis on mental math as the major difference.

The teachers reported that they had made many changes in their teaching as a result of the workshops. "I have a different outlook to math." "Moving away from stressing computation to practicing application." They said they were using manipulatives, calculators and learning centers more than they had before. Many teachers said they were using mental math techniques now --and using them every day. They reported that problem-solving and hands-on activities were more common in their classes and that their classes had much more variety, energy, activity and fun. "Entire class more involved." Several teachers commented that they felt a new enthusiasm and confidence in their teaching. "I'm more open and more comfortable getting away from the textbook." "I've been energized--HOPE IT SHOWS!"

The teachers were asked to rate (on a 5-point value scale) the effectiveness of the workshops in showing them how to teach their students some of the major mathematical competencies promoted in the *Standards*. The average response to all six competencies listed was 4.23. The average responses to each competency were: a) using mathematical problem solving, 4.20, b) communicating mathematically, 4.16, c) reasoning mathematically, 4.28, d) recognizing connections between mathematical ideas, 4.09, e) valuing mathematics, 4.23 and f) developing confidence in mathematics, 4.41.

The questionnaire included a list which the teachers were to use, or add to, to indicate the obstacles they had encountered in their attempts to apply the workshop methods in their classrooms. The list comprised some of the most common barriers to the adoption of educational innovations by teachers. Of the eight items on the list, two of them--insufficient time and inadequate facilities or materials--accounted for almost 94% of the responses. None of the teachers found the methods incompatible with his or her teaching style or school's educational objectives. Ten teachers thought they needed more training in the methods. Eight teachers thought they hadn't had enough follow-up support. Two teachers indicated that the methods disrupted classroom discipline. And one teacher was not convinced that the methods work.

The final item on the questionnaire was to determine how many of this year's workshop participants had also participated in last year's series. Forty-three percent of the teachers indicated they had attended at least one of the workshops last year, 36%--at least two, 29%--at least three, 25%--at least four, and 17%--at least five. Eleven percent had attended all six. Fifty-seven percent of this year's participants were newcomers to the project.

Evaluation Results: The Telephone Interviews

"I really believe it's changed the way I do math and the way my kids do math."

"Overjoyed that I got to go to them."

To supplement data collected from the written questionnaires, twenty-nine of the 30 participants who had attended all five of the teachers' workshops were interviewed by telephone. A copy of the interview instrument can be found in Appendix B.

The first question of the telephone interview dealt with major themes of the workshop series. Twenty-eight respondents said they had seen a consistent major theme throughout the series. The themes they identified were: improving mathematics teaching, teaching with hands-on manipulatives, mental math, teaching the higher-order thinking processes, and making math

classes exciting, involving, active and fun.

Twenty-eight of the teachers said they were using some of the workshop ideas and techniques in their classes. The most commonly mentioned of these were mental math, tiles, learning centers, sum fun, calculators and the hundreds chart. Many reported frequent use of the techniques. Several said they used mental math every day. Most reported using some of the techniques at least two or three times a week.

Half of the respondents said the ideas and techniques had become integrated into the rest of their teaching. Most of the others said that integration would soon occur. Several of the teachers who reported integration said they were using the workshop ideas and techniques in other subjects, as well--language arts, science and social studies.

Twenty of the teachers said that they had adapted the methods to fit their individual teaching needs. Most of the others said that adaptation hadn't been necessary--that the methods could be applied directly in their classrooms. Several of the teachers said they had to adapt the methods for grade-level appropriateness.

Twenty-seven of the teachers said that the workshop methods had positive effects on their students' learning. One teacher was uncertain about the effect. A change that most of the teachers saw was their students' improved attitude toward math. They reported that their students were more excited, more independent, more involved, more confident, more attentive and more interested in math now. A few teachers also reported that their students' math skills had improved. "They are better thinkers. They reason better." "They're better at brainstorming." "It helped them with their problem solving." "Mental math has helped them with their skills."

When asked about what workshop information and experiences they had shared, the teachers responded that they had shared a lot. Several of the teachers told about school inservices they had given on workshop topics. Others said they had shared workshop information in the lunchroom, in faculty meetings and with school corporations. One teacher said she was "working to give a PIVOT all-school workshop next year." Another said she had shared some ideas with parents for summer math activities at home. The teachers had shared handouts and materials from the workshop, as well as specific favorite methods, notably mental math, learning centers, tiles, games and calculator activities. Only one teacher said that her principal had been unaware of the workshop series. A few teachers commented that their principals had shown special interest in the series.

All of the teachers said that they needed something in terms of materials, facilities, time or support in order to better implement the workshop methods. In terms of materials and facilities, the teachers mentioned calculators, manipulatives, overhead projectors and Marcy Cook's books. Nearly everyone said they needed more time--time to prepare the lessons and make the materials the new teaching methods require. In terms of support, several teachers said that they wanted workshops like these to continue and that they needed the stimulation the workshops provided to "keep on with this." "The workshops were very, very profitable. Much more valuable than taking more courses." "The workshops were wonderful!" "The workshops were terrific!"

Conclusions and Recommendations

Nearly all of the participants in this workshop series responded very positively to the experience. They found the workshops socially enjoyable, mentally stimulating and professionally rewarding, enriching and challenging. The evaluation data leave no doubt that, with the possible exception of the last session, this series was an definite success. The project achieved what it set out to do--and more. One suspects that it stimulated even more enthusiasm and interest among the

participants than the project designers had anticipated. The major evaluation conclusions and recommendations are discussed below.

1. The participating teachers and principals supported the *Standards*-based approach to mathematics education espoused in the series. Their responses on evaluation instruments were congruent with the *Standards* principles and recommended teaching methods. They saw this as the "approach for the future, the direction to go in." They believed the approach was philosophically and educationally sound.

2. The teachers were very enthusiastic about the approach, the ideas and techniques presented in the series. The workshops excited and inspired them. Data from the comprehensive questionnaire indicate the effects were sustained for weeks and months after a session and reinforced by attending another workshop.

3. During the project period, student attitudes toward math improved as a result of their teachers' attending the workshops. With the new ideas and techniques--and with their teachers' new enthusiasm--student interest and pleasure in math lessons increased.

4. The teachers applied the new ideas and techniques in their own classrooms soon after attending the workshops and continued to use them frequently. Some of the methods were used more than others--mental math, tiles and learning centers, in particular.

5. The most valuable feature of each workshop, in the teachers' view, was its presentation of practical applications for the classroom. The teachers were not very interested in theoretical discussions. They wanted many hands-on examples and demonstrations of how to use the techniques in their classrooms. They were especially fond of "quick and easy" applications. Most of the teachers found the workshops particularly worthwhile in this respect.

6 In reporting the effectiveness of the methods, the teachers emphasized how much fun the methods are. Their comments made no distinctions between the pleasure of the methods and their instructional efficacy. And they made few observations about student improvements in math skills. Almost all of their remarks about students had to do with affective changes.

7. It is unclear whether the workshops included information on how teachers might monitor the instructional efficacy of the methods presented. Based on participant comments, if such information was provided, the teachers did not retain it or choose to use it. Whether produced and presented by the project staff or the workshop presenters, a project of this sort should include guidelines for teachers on how to systematically and objectively evaluate the utilization and effectiveness of the methods presented. One approach would be to ask each presenter to address the issue during his or her session. Another approach would be for the project staff to develop an evaluation system for this purpose. Such a system might, for instance, be presented in a few handouts for the teachers to use on their own. Or a more elaborate system might be designed, with observations, assessments and reports involving teams of teachers and/or project staff.

8. Although "underserved" and special groups were not specifically targeted in this project, they were represented among the participants. When they--private school teachers, At-Risk tutors and special education teachers--identified themselves on the evaluation instruments, their responses were examined closely for distinguishing observations, reactions and reports. Their responses were very similar to those of the larger group and corroborate the general findings.

9. Most of the teaching methods presented needed little or no adaptation. When necessary, the teachers were able to adapt and integrate the workshop methods to suit their needs and the

needs of their students. This indicates that the methods were very appropriate for this group of teachers and that they were presented in such a way as to make the teachers comfortable with them quickly.

10. The workshop participants shared a great deal about their workshop experiences with others who had not attended. Most of the sharing was informal, for example, lunchroom conversations and team-teaching, but a remarkable amount was done in more formal settings, such as faculty meetings and building inservices. This supports the idea that some significant educational innovations--this one, for instance--can be disseminated and implemented without the intensive interventions of external agents, experts or authorities. Throughout the year, the participants were functioning as recruiters, trainers and supporters for the project.

11. After the enthusiastic participants, the most effective dissemination/implementation tools in the project were the handouts and materials that were distributed during the workshops. They made it easy to copy, share, talk about and use the workshop ideas.

12. Much of what the implementation effort requires, principals can deliver. In order to put the workshop ideas and techniques into practice, teachers need time, materials and facilities. Principals should be encouraged to support their teachers' efforts to change by scheduling more preparation time, professional days and school inservices. They should also be encouraged to find funds to purchase the materials and equipment needed to implement these methods: calculators, overhead projectors and manipulatives, for example.

13. The planning, organization and operation of the workshop series were outstanding. The general theme of the workshops was ideal for this audience. Five out of six of the speakers were excellent presenters and their messages were motivating, interesting, important and practical. Since attendance at all the workshops was good, it is assumed that publicity was effective. The handouts and materials were excellent. The fact that the workshops were scheduled over the whole school year was good in that this gave the teachers a chance to try out the new ideas for several weeks before coming to another workshop for reinforcement, revitalization and more new ideas. Thus, teacher interest, enthusiasm and involvement was sustained throughout the year. Except for a few minor faults--a microphone that was too loud, a few visibility problems and too few breaks--the workshop environments were comfortable and conducive to workshop-style learning.

Appendix B: Evaluation Instruments

Individual Workshop Questionnaires

Comprehensive Questionnaire

Telephone Interview Questions

Implementing the NCTM Standards for School Mathematics

Presentation for Principals by Paul Trafton, September 13, 1989

Please respond to the following. Place evaluations in the **box by the door** when you leave.

Please indicate your position: Principal ___ Teacher ____ Other ___

1. The topic covered in the session was:

1	2	3	4	5
(not important)				(important)

2. The overall quality of this session was:

1	2	3	4	5
(low)				(high)

3. I feel I will implement some of the ideas presented during the session.

1	2	3	4	5
(not at all)				(fully)

4. The speaker's knowledge of the session content was:

1	2	3	4	5
(low)				(high)

5. The speaker was well prepared.

1	2	3	4	5
(disagree)				(agree)

6. The speaker was interesting and enthusiastic.

1	2	3	4	5
(disagree)				(agree)

7. How familiar were you before today with the NCTM *Standards for School Mathematics*?

1	2	3	4	5
had never heard of the S.		heard of S. but not familiar w/ content		had read the S. or heard a presentation about them

Put answers to questions 8 , 9, & 10 on the back side of this sheet.

8. What are the greatest concerns or problems related to mathematics education that you have in your school?

9. The IU Mathematics Education Development Center presented Dr. Trafton's presentation as part of a series of workshops for local elementary school teachers on implementing the *Standards*. Do you have suggestions for workshop topics or format? We'd also appreciate any ideas for other ways that the Center could help you and your teachers with mathematics education.

10. Any other comments.

Implementing the NCTM
Standards for School Mathematics
in the 21st Century
Evaluation Form
Promoting Estimation and Mental Arithmetic Skills
Larry Leutzinger, October 17, 1989

Please indicate: Teacher ___ (Grade:___) Principal _____

How many, if any, of our 6 workshops did you attend last year? _____

1. The topic covered in today's session was:

   1 2 3 4 5
   (not important) (important)

2. The overall quality of this session was:

   1 2 3 4 5
   (low) (high)

3. I feel I will utilize the concepts presented during the session.

   1 2 3 4 5
   (not at all) (fully)

4. The speaker's knowledge of the session content was:

   1 2 3 4 5
   (low) (high)

5. The workshop was well organized.

   1 2 3 4 5
   (disagree) (agree)

6. The speaker was interesting and enthusiastic.

   1 2 3 4 5
   (disagree) (agree)

7. The most valuable thing(s) I learned from the workshop:

8. The session (or instructor) could be more effective if:

9. If we apply for funding for another series of workshops for next year, what math-related topics would you like to see addressed?

9. Use back side for any comments or recommendations for future workshops.

Implementing the NCTM *Standards* for School Mathematics

How the Calculator "Figures" in Your Classroom

Earl Ockenga, November 13, 1989

Please indicate: Teacher ___ (Grade:___) Principal __

How many, if any, of our 6 workshops did you attend last year? _____
Did you attend our workshop on estimation on October 17th this year? ____

1. The topic covered in today's session was:
   1 2 3 4 5
   (not important) (important)

2. The overall quality of this session was:
   1 2 3 4 5
   (low) (high)

3. I feel I will utilize the concepts presented during the session.
   1 2 3 4 5
   (not at all) (fully)

4. The speaker's knowledge of the session content was:
   1 2 3 4 5
   (low) (high)

5. The workshop was well organized.
   1 2 3 4 5
   (disagree) (agree)

6. The speaker was interesting and enthusiastic.
   1 2 3 4 5
   (disagree) (agree)

7. About how often do your students use calculators in your math work?
   daily several times a month a few times a year almost never

8. Why do you have students use calculators this frequently (or infrequently)?

9. How available are calculators for your students? (Do you have your own class set? Does the school have a class set that you can borrow? Do your students provide their own calculators?)

10. The most valuable thing(s) I learned from the workshop today was

11. The session (or instructor) could be more effective if

12. If we organized another series of workshops for next year, what math-related topics would you like to see addressed?

13. Use back side for any comments or recommendations for future workshops.

Implementing the NCTM *Standards* for School Mathematics

Reaching Instructional Goals: Using Learning Centers for Mathematics Instruction and Practice

Sue Peterson, March 1, 1990

Please indicate: Teacher ___ (Grade:___) Principal __

How many, if any, of our 6 workshops did you attend last year? _____
How many, if any, of our previous 2 workshops did you attend this year? ____

1. The topic covered in today's session was:
   1 2 3 4 5
   (not important) (important)

2. The overall quality of this session was:
   1 2 3 4 5
   (low) (high)

3. I feel I will utilize the concepts presented during the session.
   1 2 3 4 5
   (not at all) (fully)

4. The speaker's knowledge of the session content was:
   1 2 3 4 5
   (low) (high)

5. The workshop was well organized.
   1 2 3 4 5
   (disagree) (agree)

6. The speaker was interesting and enthusiastic.
   1 2 3 4 5
   (disagree) (agree)

7. About how often do your students use learning centers (for any subject)?
   daily several times a month a few times a year almost never

8. About how often do your students use learning centers <u>for math work</u>?
   daily several times a month a few times a year almost never

9. Why do you have students use learning centers this frequently (or infrequently)?

10. The most valuable thing(s) I learned from the workshop today was

11. The session (or instructor) could be more effective if

12. If we organized another series of teacher workshops, what math-related topics would you like to see addressed?

13. Use back side for any additional comments or recommendations.

Implementing the NCTM *Standards* for School Mathematics

Active Mathematical Thinking

Marcy Cook, March 20, 1990

Please indicate: Teacher ___ (Grade:___) Principal __
Other (please indicate) _____

How many, if any, of our 6 workshops did you attend last year? _____
How many, if any, of our previous 3 workshops did you attend this year? ____

1. The topic covered in today's session was:
   1 2 3 4 5
   (not important) (important)

2. The overall quality of this session was:
   1 2 3 4 5
   (low) (high)

3. I feel I will utilize the concepts presented during the session.
   1 2 3 4 5
   (not at all) (fully)

4. The speaker's knowledge of the session content was:
   1 2 3 4 5
   (low) (high)

5. The workshop was well organized.
   1 2 3 4 5
   (disagree) (agree)

6. The speaker was interesting and enthusiastic.
   1 2 3 4 5
   (disagree) (agree)

7. The most valuable thing(s) I learned from the workshop today was

8. The session (or instructor) could be more effective if

9. If we organized another series of teacher workshops, what math-related topics would you like to see addressed?

10. Any additional comments or recommendations.

Implementing the NCTM *Standards* for School Mathematics

Integrating Language Arts and Mathematics Instruction: Building a Base for Problem Solving

Dr. Calvin Irons
April 12, 1990

Please indicate: Teacher ___ (Grade:___) Principal ___
Other (please indicate) _____

How many, if any, of our 6 workshops did you attend last year? _____
How many, if any, of our previous 4 workshops did you attend this year? ____

1. The topic covered in today's session was:
   1 2 3 4 5

2. The overall quality of this session was:
   1 2 3 4 5

3. I feel I will utilize the concepts presented during the session.
   1 2 3 4 5

4. The speaker's knowledge of the session content was:
   1 2 3 4 5

5. The workshop was well organized.
   1 2 3 4 5

6. The speaker was interesting and enthusiastic.
   1 2 3 4 5

7. The most valuable thing(s) I learned from the workshop today was

8. The session (or instructor) could be more effective if

9. If we organized another series of teacher workshops, what math-related topics would you like to see addressed?

10. Any additional comments or recommendations.

Comprehensive Questionnaire

Implementing the NCTM Standards for School Mathematics for the 21st Century
Workshop Series Questionnaire

Please indicate your position: Teacher ___ (Grade ___) Principal ___

1. Was coming to these workshops professionally beneficial to you? Please explain.

2. What was different about the approach to math teaching presented in this workshop series from the approach you are accustomed to using?

3. What changes have you made in your teaching because of the workshops you attended?

4. How effective were the workshops in showing you how to teach your students to .....

   a) use mathematical problem-solving?
   1 2 3 4 5
   (ineffective) (very effective)

   b) communicate mathematically?
   1 2 3 4 5

   c) reason mathematically?
   1 2 3 4 5

   d) recognize connections among mathematical ideas?
   1 2 3 4 5

   e) value mathematics?
   1 2 3 4 5

   f) develop confidence in mathematics?
   1 2 3 4 5

5. Check each workshop you attended. Then, in the space provided, briefly summarize the ideas and/or techniques from the workshops that you have used in your classes. How effective were these ideas and techniques in practice? What successes or difficulties did you have in applying them in the classroom?

___ **Promoting Estimation and Mental Arithmetic Skills (Larry Leutzinger)**
   a) Answer to questions in 5. above.

   b) How useful were the handouts and materials you received at this workshop?
   1 2 3 4 5
   (not useful) (very useful)

   c) With how many teachers have you shared something from this workshop experience?
   Please circle: 1-3 4-6 7-9 10 +
   Describe what you shared with them:

Please go on to other side.

___ **How the Calculator "Figures" in Your Classroom (Earl Ockenga)**

a) Answer to questions in 5. above.

b) How useful were the handouts and materials you received at this workshop?

1 (not useful) 2 3 4 5 (very useful)

c) With how many teachers have you shared something from this workshop experience?

Please circle: 1-3 4-6 7-9 10 +

Describe what you shared with them:

___ **Using Learning Centers for Math Instruction and Practice (Sue Peterson)**

a) Answer to questions in 5. above.

b) How useful were the handouts and materials you received at this workshop?

1 (not useful) 2 3 4 5 (very useful)

c) With how many teachers have you shared something from this workshop experience?

Please circle: 1-3 4-6 7-9 10 +

Describe what you shared with them:

___ **Active Mathematical Thinking: Keep Their Minds in Motion (Marcy Cook)**

a) Answer to questions in 5. above.

b) How useful were the handouts and materials you received at this workshop?

1 (not useful) 2 3 4 5 (very useful)

c) With how many teachers have you shared something from this workshop experience?

Please circle: 1-3 4-6 7-9 10 +

Describe what you shared with them:

6. Listed below are some possible obstacles to your applying the workshop methods in your classes? Please check the appropriate statements and, if necessary, add to the list.

___ The methods are incompatible with my teaching style.
___ The methods are incompatible with my school's educational objectives.
___ The methods disrupt classroom discipline.
___ I don't have the necessary facilities and/or materials to use the methods.
___ I don't have enough time to develop applications for the methods.
___ I haven't had enough training in how to use the methods.
___ I haven't had enough follow-up support.
___ I'm not convinced the methods work.
___ (Others)_____

_____

Please explain:

Circle the number of workshops you attended **last year** (1988-89): 1 2 3 4 5 6

Thank you for your participation.

Telephone Interview Questions

Teacher's Name _____ **Grade Level** _____

Teacher's School _____

Interviewer's Name _____

Interview Time _____ **Interview Date** _____

Introduction: Hello. My name is _____. I am calling from the Mathematics Education Development Center at Indiana University in Bloomington. I understand you attended all five of the workshops we hosted this past school year on "Mathematics for the 21st Century." We're currently putting together our final report on those workshops to the Department of Education. We want to include information from interviews with teachers in the report and would like to ask you a few questions about your workshop experiences. This should take about 10 minutes. Is this a good time to talk? **(Assuming teacher agrees, continue. Otherwise, try to set up another time to call back.)**

Interview Questions:

1. Did you see a major theme throughout the workshop series?

2. Is your principal aware of the workshop series?

3. Have you used the ideas and techniques from the workshops in your classes? Which ones? How often have you used them? Did they work? Why/why not?

(If answer to question #3 is affirmative, ask questions #4 through #6.

If answer is negative, go to question #7.)

4. Have these ideas and techniques become integrated into the rest of your teaching?

5. Have you adapted these ideas and techniques in any way to better fit your teaching needs?

6. What effect have these ideas and techniques had on your students' learning?

7. What from the workshops have you shared with other teachers who did not attend the workshops? (Ideas, techniques, materials, handouts, experiences?)

8. What do you need in terms of materials, facilities, time or support to better use the workshop ideas and techniques in your classes?

To the Interviewer: The workshop titles, dates and speakers are listed below. It may be helpful to refer to this list during the interviews.

Promoting Estimation and Mental Arithmetic Skills (Oct. 17, 1989)

by Larry Leutzinger

How the Calculator "Figures" in Your Classroom (Nov. 13, 1989)

by Earl Ockenga

Using Learning Centers for Math Instruction and Practice (March 1, 1990)

by Sue Peterson

Active Mathematical Thinking: Keep Their Minds in Motion (March 20, 1990)

by Marcy Cook

Integrating Language Arts and Mathematics Instruction: Building a Base for Problem Solving (April 12, 1990)

by Dr. Calvin Irons

Appendix C: Recruiting Brochure

Implementing the NCTM Standards for School Mathematics in the 21st Century

Mathematics Education Development Center at Indiana University

A Series of Inservice Workshops for Elementary School Teachers in the Monroe County Area

Using federal Title II funds, the Indiana Higher Education Commission has funded a series of six inservice workshops focusing on key issues in the teaching of mathematics at the elementary school level. The first workshop is for principals, and the five subsequent workshops are for teachers from their schools.

The workshop for elementary principals will provide an overview of the *Standards for School Mathematics* recently released by the National Council of Teachers of Mathematics. The speaker will be Dr. Paul Trafton, a former IU professor who served as chair of the K-4 working group that drafted the NCTM *Standards*.

The five subsequent teacher workshops will be held in the afternoon throughout the school year, and each will feature a nationally known speaker who will inform teachers about promising and innovative practices related to the new NCTM *Standards*. Speakers will provide the examples, materials, and hands-on experience necessary to allow these innovations to be put into immediate classroom use.

Each elementary school in the Monroe County Community School Corporation is invited to send three teachers. Additional spaces have been reserved for private school personnel and for a limited number of teachers from schools outside of Monroe County. *The workshops have been organized with the expectation that teachers will attend all five teacher workshops.* MCCSC teachers who attend the October 17th workshop will receive 2 hours of fall PIVOT credit, and they will receive 2 hours of spring PIVOT credit for attending each of the spring workshops.

The workshops are organized by the Mathematics Education Development Center at Indiana University. For more information, call Diana Kroll, director of the workshop series, at (812) 855-0860.

Proposed Topics and Speakers

Wednesday, September 13, 1989
Workshop for Principals
Overview of the NCTM Standards
1:30-3:30 pm at Terry's, Westbury Village (intersection of St. Rds. 37 & 46). Paul Trafton, chair of the working group that drafted the K-4 section of the recently released NCTM *Standards* will provide an overview of the *Standards* for elementary school principals. A faculty member at National College of Education in Illinois, Dr. Trafton has spoken throughout the nation during the two years to bring information about the *Standards* to the educational community.

October 17, 1989,
Workshop for Teachers
Estimation & Mental Arithmetic 3:45-4:45 pm at Terry's, Westbury Village. Larry Leutzinger, of the University of Northern Iowa will present a workshop on promoting estimation and mental arithmetic skills. He'll provide examples of quick daily mental math activities for every grade level, as well as discussing the importance of devloping estimation skills in children of our calculator age.

November, 1989
Workshop for Teachers
How the Calculator "Figures" in Your Class
4:00-6:00 pm at Terry's, Westbury Village. Bring a Calculator!!
Earl Ockenga, 1989 Iowa Teacher of the Year, will provide hands-on work with calculators for teachers K-6. Dr. Ockenga brings first-hand experience in the classroom as well as innovative ideas. He teaches at the Price Laboratory School in Cedar Falls, Iowa, and has long been active as an author of elementary school mathematics materials.

MARCH 1, 1990
Workshop for Teachers
Using Learning Centers for Mathematics Instruction and Practice 4:00-6:00 pm at Terry's Westbury Villaga. Sue Peterson of the Gilbert, Arizona, Public School System will present ideas for mathematics learning centers to help promote conceptualization and reinforce and enrich textbook programs through more interesting and active mathematics activities

March 20, 1990
Workshop for Teachers
Active Mathematical Thinking: Keep Their Minds in Motion
4:00-6:00 pm at Terry's Westbury Village. Marcy Cook from Balboa Island, California, will present a workshop for using innovative mathematics curriculum materials for elementary children.

April 12, 1990
Workshop for teachers
Integrating Language Arts and Mathematics Instruction: Building a Base for Problem Solving 4:00-6:00 pm at Terry's Westbury Village. Calvin Irons from Brisbane, Australia, is an active textbook author and developer of curriculum materials and has considerable experience working with elementary-aged children. He will be speaking on the impact of language arts on the process of problem solving.

Who To Contact

MCCSC teachers who are interested in participating should contact their principals.

Personnel from private schools and from schools outside of MCCSC may apply by contacting Diana Kroll by phone (855-0860) or by mail (Indiana University, Education 309, Bloomington, IN 47405).

Any individuals wishing additional information may contact Diana Kroll at 855-0860.

Appendix D: List of Schools Invited to Participate

This specific information is not included in this version of the project report. Those who have legitimate need to know exactly which schools were invited to participate may contact the project director.

Appendix E: Lists of Participants

List of Participants at Principals' Workshop

List of Participants at Teachers' Workshops (by School Corporation)

List of Participants at Teachers' Workshops (by Number of Workshops Attended)

This specific information is not included in this version of the project report. Those who have legitimate need to know exactly which individuals and schools participated may contact the project director.